



X-Plain™ *Leukemia*

Reference Summary

Leukemia is the name of a group of cancers of the blood cells. Almost 27,000 adults and more than 2,000 children in the United States are diagnosed with leukemia each year.

There are different types of leukemia and several treatment options for each type.

This reference summary explains what leukemia is and reviews the causes, symptoms, diagnosis, and treatment options of it.

Cancer

The body is made up of very small cells. Normal cells in the body grow and die in a controlled way.

Sometimes cells keep dividing and growing without normal controls, causing an abnormal growth called a tumor.

If a tumor does not invade nearby tissues and body parts, it is called a benign tumor, or non-cancerous growth. Benign tumors are almost never life threatening.

If the tumor invades and destroys nearby cells, it is

called a malignant tumor, or cancer. Cancer can sometimes be life threatening.

Cancerous cells sometimes spread to different parts of the body through blood vessels and lymph channels.

Lymph is a clear fluid produced by the body that drains waste from cells. It travels through special vessels and bean-shaped structures called lymph nodes.

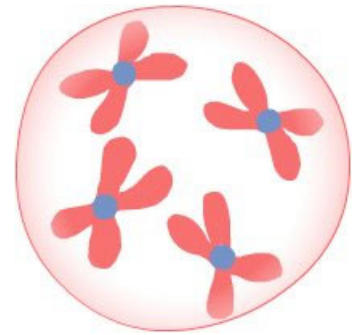
Cancer treatments are used to kill or control abnormally growing cancerous cells.

Cancers in the body are given names, depending on where the cancer started. Cancer that begins in the pancreas will always be called pancreatic cancer, even if it spreads to other places in the body.

Although doctors can locate where a cancer started, the cause of cancer in an individual patient cannot always be identified.

Cells contain hereditary, or genetic, materials called chromosomes. Chromo-

somes control the growth of cells.



Cancer always arises from changes that occur in the chromosomes. When the chromosomes in a cell become abnormal, the cell can lose the ability to control its growth.

Sudden changes in genetic material can happen for a variety of reasons. These changes are sometimes inherited.

Changes in chromosomes may also occur as a result of exposure to infections, drugs, tobacco, chemicals, or other factors. In the case of skin cancer, sunlight causes damage to the chromosomes leading to cancer.

Leukemia

Leukemia is cancer of the blood cells. Normal blood is

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made of a fluid called plasma and 3 types of cells:

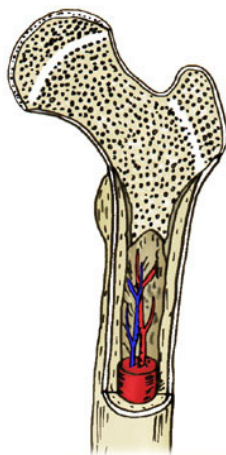
- white blood cells
- red blood cells
- platelets

White blood cells, also called WBCs or leukocytes, help the body fight infection and disease.

Red blood cells, also called RBCs or erythrocytes, carry oxygen from the lungs to the body's tissues. They also take carbon dioxide from the tissues back to the lungs. The red blood cells give blood its red color.

Platelets, also called thrombocytes, help blood to clot when a person is injured. By clotting, bleeding is controlled and the injured person does not lose excessive amounts of blood.

Blood cells are formed in the soft, spongy center of bones called the bone marrow. New, undeveloped blood cells are called blasts. Some blasts stay in the marrow to mature, while some travel to other parts of the body to mature.



Normally, blood cells are produced in a controlled way, as the body needs them. This process helps keep us healthy.

When leukemia develops, the body produces large numbers of abnormal white blood cells.

The leukemia cells usually look different from normal white blood cells, and they do not function properly.

There are currently no known causes of leukemia. However, researchers have found certain risk factors that increase a person's risk of getting leukemia.

Some of the risk factors include:

- Exposure to high-energy radiation, such as atomic radiation seen in survivors of the Hiroshima and Nagasaki bombs
- Genetic conditions, such as Down's syndrome

- Long exposure to chemicals such as benzene

Leukemia is commonly labeled by how quickly it develops and gets worse. In acute leukemia, the disease gets worse quickly. In chronic leukemia, the disease gets worse gradually.

Leukemia can also be labeled based on the type of white blood cells it affects. Lymphocytic leukemia and myelogenous leukemia are 2 such examples.

The following table shows the most common types of leukemia:

	Lymphocytic Leukemia	Myelogenous Leukemia
Acute	ALL ¹	AML ²
Chronic	CLL ³	CML ⁴

Symptoms

Leukemia cells are abnormal cells that cannot do what normal blood cells do. They cannot help the body fight infections. For this reason, people with leukemia often get infections and have fevers.

Leukemia patients often do not have enough healthy red blood cells or enough platelets. As a result, the body does not receive enough oxygen.

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Without enough red blood cells, the patient has a condition called anemia. Anemia causes patients to look pale and feel weak and tired. Without enough platelets, patients bleed and bruise easily.

In chronic leukemia, symptoms may not appear for a long time. When symptoms do appear, they are generally mild at first and get worse gradually. Doctors often find chronic leukemia during a routine checkup, before there are any symptoms.

Some of the common symptoms of leukemia include:

- fever or chills
- weakness and fatigue
- frequent infections
- weight-loss
- swollen or tender lymph nodes,
- easy bleeding or bruising

Other symptoms of leukemia include

- tiny red spots, called petechiae, under the skin, caused by abnormal bleeding
- swollen or bleeding gums
- sweating, especially at night
- bone or joint pain

Like all blood cells, leukemia cells travel through the body. Depending on where these cells accumulate, patients with leukemia may have a number of symptoms.

If leukemia cells collect in the brain or spinal cord, the result may be headaches, vomiting, confusion, loss of muscle control, and seizures.

If leukemia cells collect in the testicles, the testicles may become swollen.

Some patients develop sores in the eyes or on the skin. Leukemia also can affect the digestive tract, kidneys, lungs, or other parts of the body.

Diagnosis

In order to diagnose leukemia, the doctor takes a detailed medical history and does a thorough physical examination.

Blood tests also help in diagnosing leukemia. A sample of blood is examined under a microscope to see what the cells look like and to determine the number of mature cells and blasts.

Although blood tests may reveal leukemia, they may not show what type it is.

To check further for leukemia cells or to tell what type of leukemia a patient has, a hematologist, oncologist, or

pathologist examines a sample of bone marrow under a microscope.

A bone marrow aspiration is one way to collect a bone marrow sample. The doctor inserts a needle into a large bone, usually the hip, and removes a small amount of liquid bone marrow.

A bone marrow biopsy is another way to collect a bone marrow sample. It is performed with a larger needle and removes a small piece of bone and bone marrow.

If leukemia cells are found in a bone marrow sample, the doctor orders more tests to find out the extent of the disease. A spinal tap checks for leukemia cells in the fluid around the brain and spinal cord.

Chest x-rays can reveal signs of leukemia in the chest.

Treatment

Treatment for leukemia is complex. It varies depending on the type of leukemia and is not the same for all patients.

Leukemia treatment depends on

- the type of leukemia
- the extent of the disease
- whether the leukemia has been treated before

- the patient's age, symptoms, and general health.

Acute leukemia should be treated right away. The main goal of treatment is to stop the disease. This is also called remission.

The other goal of leukemia treatment is to prevent it from occurring again or relapsing. Many people with acute leukemia can be cured.

Chronic leukemia patients who do not have symptoms may not require immediate treatment. However, frequent checkups are important.

Treatment may be used to control the disease and its symptoms. Chronic leukemia can seldom be cured.

Most patients with leukemia are treated with chemotherapy. Some may also have one or more of the following:

- radiation therapy
- bone marrow transplantation (BMT)
- biological therapy
- surgery to remove the spleen, called a splenectomy

Many patients with leukemia take part in clinical trials. Clinical trials are experiments designed to find out whether a new treatment is safe and effective. These

treatments are usually thought to be at least as effective as the most effective treatment available.



It is hard to limit the effects of therapy so that only leukemia cells are destroyed. Since treatment also damages healthy cells and tissues, it causes side effects.

The side effects of cancer treatment vary, depending on the type and extent of treatment. In addition, each patient reacts differently.

Side effects may even be different from one treatment to the next. Doctors try to plan the patient's therapy to keep side effects at a minimum.

In addition to killing cancer cells, doctors treat the symptoms and complications of leukemia.

For example, infections are usually treated with antibiotics.

Bleeding may be treated with a blood transfusion.

Loss of appetite is treated with a good nutrition program.

Patients with leukemia can stay healthy by

- avoiding people with colds and other infectious diseases.
- eating well
- following good dental care and hygiene before and after treatment.

Chemotherapy

Chemotherapy is the use of drugs to kill cancer cells. Depending on the type of leukemia, patients may receive a single drug or a combination of 2 or more drugs.

Some anticancer drugs can be taken by mouth. Most are given by injection into a vein. This is called an IV injection.

Anticancer drugs enter the bloodstream and affect leukemia cells in most parts of the body.

However, the drugs often do not reach cells in the brain and spinal cord because they are stopped by a protective barrier that filters blood going to the brain and spinal cord. This barrier is called the blood-brain barrier.

To reach leukemia cells in the central nervous system,

doctors use intrathecal chemotherapy. In this type of treatment, anticancer drugs are injected directly into the cerebrospinal fluid, the fluid surrounding the brain and spinal cord.

Intrathecal chemotherapy can be given by injection into the lower part of the spinal column. It can also be given through a special type of device placed under the scalp with a catheter that reaches the cerebrospinal fluid in the center of the brain.

Chemotherapy is given in cycles: a treatment period followed by a recovery period, then another treatment period, and so on.

Depending on which drugs are given and the patient's general health, chemotherapy may be given at a hospital, a doctor's office, or at home.

Chemotherapy can also affect healthy cells. This can cause among other side effects:

- Infections
- Hair loss
- Vomiting and nausea
- Mouth sores

Most side effects go away gradually during recovery periods between treatments or after treatment stops.

Some anticancer drugs can affect a patient's fertility. Women's menstrual periods may become irregular or stop, and women may have symptoms of menopause, such as hot flashes and vaginal dryness.

Since some medications can cause birth defects, women of childbearing age are usually asked to use contraception if sexually active.

Men may stop producing sperm. Since these changes may be permanent, some men choose to have their sperm frozen and stored.

Radiation Therapy

Radiation therapy is used with chemotherapy for some kinds of leukemia. Radiation therapy, also called radiotherapy, uses high-energy rays to damage cancer cells and stop them from growing. The radiation comes from a large machine.

Radiation therapy for leukemia may be given in one of 2 ways. For some patients, the doctor may direct the radiation to one specific area of the body where there is a collection of leukemia cells, such as the spleen or testicles.

Other patients may receive radiation that is directed at the body as a whole. This type of radiation therapy, called total-body irradiation,

is usually given before a bone marrow transplant.

Patients receiving radiation therapy may become very tired. Resting is important, but doctors usually suggest that patients remain as active as they can.

When radiation is directed to the head, patients often lose hair. Radiation can cause the scalp or the skin in the treated area to become red, dry, tender, and itchy.

Patients are shown how to keep the skin clean during radiation treatment. Lotion or cream should not be used on the treated area without the doctor's advice.



Radiation therapy can also cause nausea, vomiting, and loss of appetite. These side effects are temporary, and doctors and nurses can often suggest ways to control them until treatment is over. However, some side effects of radiotherapy may be long lasting.

Young children who receive radiation to the brain may develop problems with learning and coordination. For this reason, doctors use the lowest possible doses of radiation, and they give this treatment only to children who cannot be treated successfully with only chemotherapy.

Radiation to the testicles is likely to affect both fertility and hormone production. Most boys who have this form of treatment are not able to have children later on. Some may need to take replacement hormones.

Bone Marrow Transplantation

Bone marrow transplantation may be used for some patients. The patient's leukemia-producing bone marrow is destroyed by high doses of drugs and radiation. It is then replaced by healthy bone marrow.

Healthy bone marrow may come from a donor, or it may be removed from the patient and stored before the high-dose treatment. If the patient's own marrow is used, it is usually treated outside the body to remove leukemia cells.

Patients who have a bone marrow transplant usually stay in the hospital for several weeks. Until the trans-

planted bone marrow begins to produce enough white blood cells, patients must be carefully protected from infection.

Patients who have a bone marrow transplant face an increased risk of infection, bleeding, and other side effects of chemotherapy and radiation.

Donated marrow may react against a patient's tissues. This is known as graft-versus-host disease or GVHD. GVHD can be mild or very severe and can occur any time after a transplant.

Summary

Leukemia is a common form of cancer of the blood cells. There are several types of leukemia that require different treatments.

Thanks to recent medical advances, treatment of leukemia has improved dramatically in the last 10 to 20 years. This has resulted in frequent cures and long-term survival!

¹ Acute lymphocytic leukemia (ALL) is the most common type of leukemia in young children. This disease also affects adults, especially over the age of 65.

² Acute myeloid leukemia (AML) occurs in both adults and children. This type of leukemia is sometimes called acute nonlymphocytic leukemia (ANLL).

³ Chronic lymphocytic leukemia (CLL) most often affects adults over the age of 55. It sometimes occurs in younger adults, but it almost never affects children.

⁴ Chronic myeloid leukemia (CML) occurs mainly in adults. A very small number of children also develop this disease.